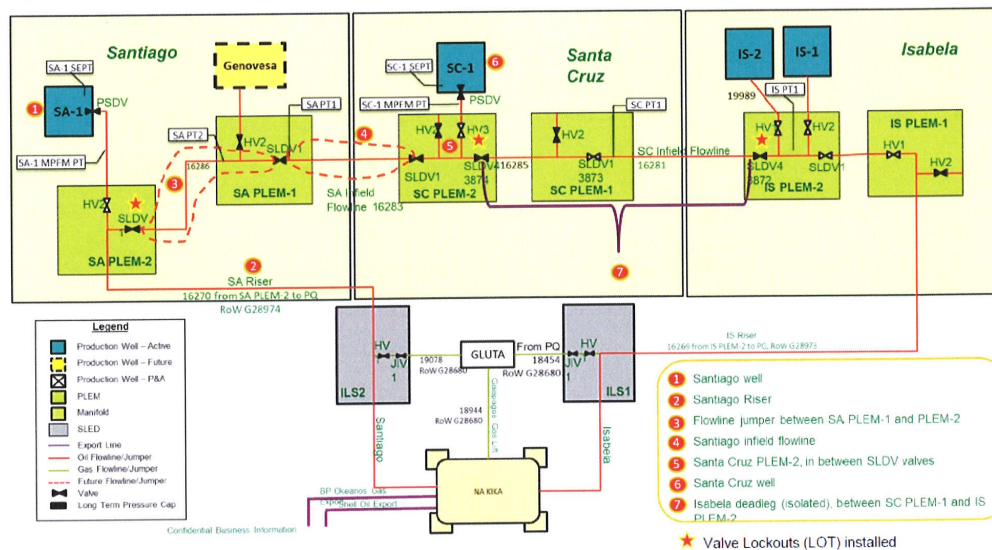


Revision 4 of Galapagos LSPS Response Corrective Action Plan

1. Galapagos Layout

The Galapagos loop subsea production system (LSPS) is in the Mississippi Canyon Area (MC) Blocks 561 and 519, at water depths between 6,300ft and 6,550ft. The LSPS ties back to the host facility at Na Kika. Figure 1 illustrates a schematic of the field.



2. History

The following information has led to implementation of a near-term Corrective Action Plan.

March 2020 – Santiago (SA) side of Galapagos Loop was shut in with dead oil and stabilized below hydrostatic pressure.

April 2020 – Ingress was identified through trending and remotely operated vehicle (ROV) visual monitoring during an offshore campaign. ROV inspections did not identify any signs of an ingress point.

May 2020 – Diagnostics completed with ROV onsite during which Santa Cruz (SC) PLEM2 and SA PLEM1 were exposed to above hydrostatic pressure (~3,300psi for 6hrs). Trending and ROV visual monitoring did not identify any fluid egress. No issues identified with SA flowline jumper, SA riser, SA flowline and SA PLEM2. However, potential ingress location deemed to be either SC PLEM 2 or SA PLEM 1.

June 2020 – Further diagnostics completed but BP was unable to pinpoint ingress source.

July 2020 – Performed static 4,000psi pressure hold for ~23hrs. Trending and ROV visual monitoring did not identify any egress. Initiated dead oil circulation and after ~9.5hrs at 4,000psi and 120deg F, pea-size bubbles were seen at SC PLEM-2 SLDV1 valve (one (1) bubble every 30-45s). No sign of egress was observed at SA PLEM1. Circulation was stopped, system was bled down below hydrostatic and egress

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rate decreased to one (1) bubble per hour. ROV vessel returned for another inspection one (1) week later and no bubbles were observed.

13 - 14 August 2020 – Lockout devices were installed on some SLDVs to maintain current isolations.

14 August 2020 – ROV inspection confirmed no further leak from SC PLEM2 SLDV1.

3. Summary of Previously Approved Corrective Action Plan (CA83P)

3 - 5 September 2020 – Insulation was removed (Figure 2) at grease port locations and other areas where it had disbonded on the SLDV1 valve located at the SC PLEM2. While the insulation removal campaign was unable to identify the leak source, results indicated that additional insulation removal would increase the probability of determining the leak source.



Figure 2: Insulation Removal Results for Grease Port and Disbonded Insulation (Targets 1-3)

25 - 29 September 2020 – Following approval of previous Corrective Action Plan on 14 September 2020, additional insulation was removed (Figures 3 – 5) as attempts to pressurize the SC PLEM2 failed due to lack of communication to the bore.



Figure 3: Additional Insulation Removal Targets (Targets 4-6)

While additional insulation removal was unable to identify the leak source, visibility at the areas of interest (targets) had been improved and the likelihood of finding the leak source during pressurization has increased.



Figure 4: Insulation Removal Results for Targets 4, 5a and 5b



Figure 5: Insulation Removal Results for Target 6

13 - 20 October 2020: During this campaign, communication to the valve bore and subsequent pressurization was achieved via ROV. Presence of ingress/egress was not witnessed by ROVs during 44 hours of pressure testing as the SLDV1 valve at SC PLEM2 was cycled open to closed position for one (1) hour during the below hold times.

A summary of the pressures and hold times are provided below:

- First Test: Pressurized to roughly 5,000 psia at a hold time of 8 hours.
- Second Test: Pressurized to roughly 6,000 psia at a hold time of 24 hrs.
- Third Test: Pressurized to roughly 8,500 psia and held for 12 hrs.

10 – 16 November 2020: During dead oil circulation, the ROV observed dead oil or other fluid egress from the SLDV1 valve located at SC PLEM 2. The egress source origination point was identified as the gasket seal located between the valve bonnet and valve body; see Figure 6. ROV was utilized to collect the egressed volume located under the containment dome and the collected sample bottle returns were sent to Core Labs for testing, [which found no hydrocarbons in the samples](#). No additional egress points were identified during the circulation test.



Figure 6: Egress Location

Egress Details:

Egress was witnessed at 14:40 on 15 November following roughly 36 hours of circulation. The egress rate was estimated to be a single pea size bubble (1 cm^3) releasing at an interval of 1 to 2 minutes. The last witnessed release was at 04:23 on 16 November, with the pressure in the SC2 PLEM returning to below hydrostatic conditions at roughly 5:15. The volume of the release is therefore estimated to be between 411 cm^3 (.10 gal) and 875 cm^3 (.23 gallons). No additional bubbles were observed after the pressure was returned to below hydrostatic conditions.

7 – 10 January 2021: Additional insulation removal was performed to provide access to the bonnet nuts for torquing with the ROV (see figure 7 below). Following the completion of insulation removal, the ROV utilized a Hytorc hydraulic impact wrench to apply OEM specified torque (2,499 ft-lbs) to the flange nuts (qty 16), following the OEM/API recommended star pattern. A total of two passes were performed by the ROV, resulting in slight movement in several of the nuts (see figure 8). Following the completion of the torquing, the ingress test was initiated and indicated no change to the pressure containment integrity of the joint.

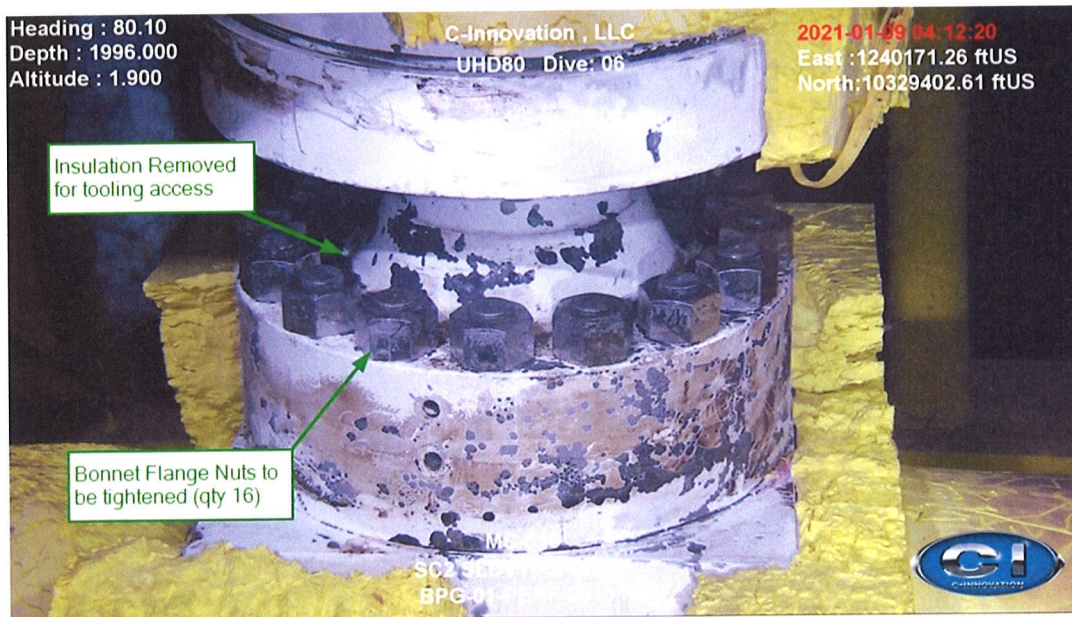


Figure 7: Completed Insulation Removal for Bonnet Bolt Access

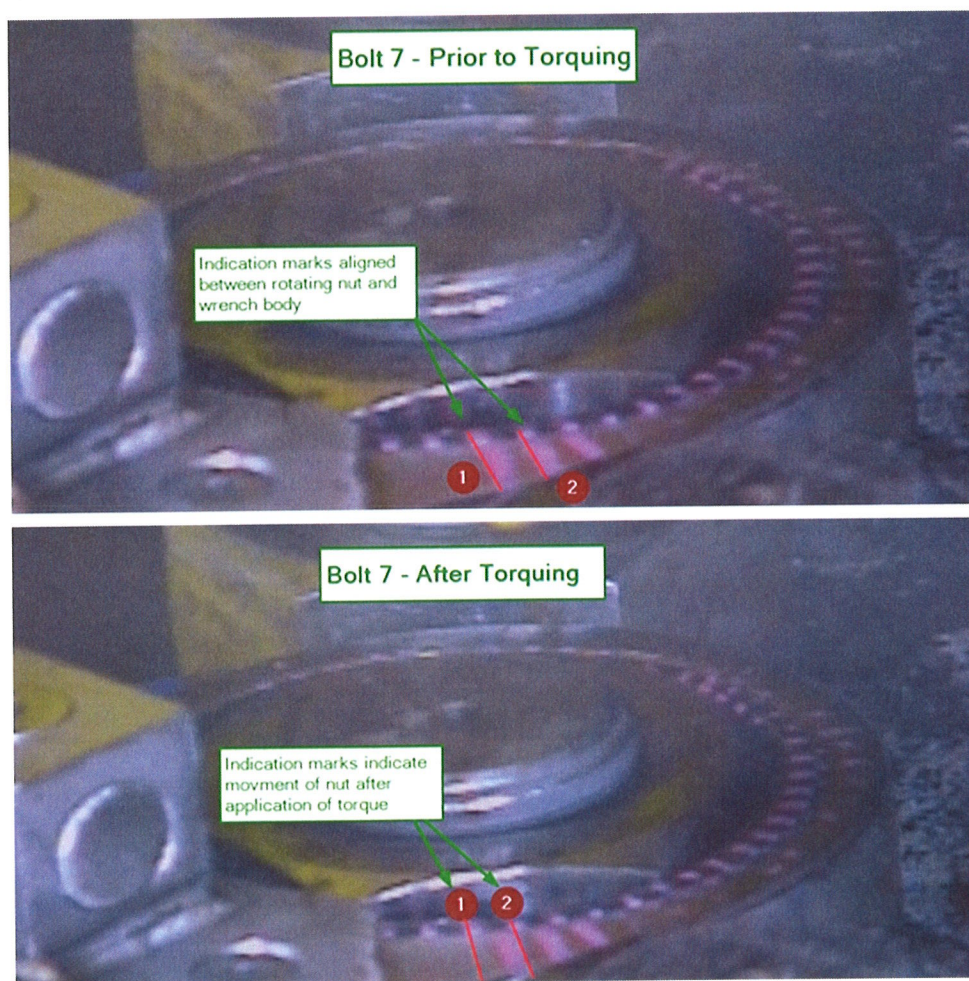


Figure 8: Nut Movement after Application of OEM Torque

3.1 Current Status

The current status of the affected segments in the Galapagos loop is as follows:

- SC-1 and SA-1 wells remain shut in and safed-out.
- Flowline segment remains filled with dead oil at below hydrostatic ambient pressures (~2,900psi). Pressures are monitored via flowline transducers. System pressures as of 21 January 2021 are as follows:
 - SC PLEM-2 at 2,230 psi.
 - SA flowline at 2,130 psi
 - SA flowline jumper at 2,128 psi
- ROV installable mechanical valve lock closed devices remain installed on two (2) PLEM valves (SLDV1 3873 and SLDV4 3872) for LSPS loop isolation from the area of ingress/egress.

4. Future Corrective Action Plans

Given that the ingress point was not mitigated following the campaign, BP is working on long-term Corrective Action Plans. The long-term plans are being generated based on the findings from the previous campaigns, and may include:

- Additional Repair Attempts
- Recover the PLEM from seabed and replace/repair.
- Reroute the pipeline to a new PLEM structure.

Any new Corrective Action Plan that is prepared will be submitted to BSEE for approval.